Butler University Botanical Studies

Volume 3 *Butler University Botanical Studies* Article 16

Soil Moisture and the Nature of the Tsuga and Tsuga-Pinus Forest Associations in Indiana

Ray C. Friesner
Butler University

John E. Potzger
Butler Universtiy

SOIL MOISTURE AND THE NATURE OF THE TSGUA AND TSUGA-PINUS FOREST ASSOCIATIONS IN INDIANA

By RAY C. FRIESNER *and* JOHN E. POTZGER

Nichols (6) concludes that "white pine, throughout a large part of its geographical range, is a normal, although minor, constituent of the climatic climax forest." He maintains that the Tsuga-Pinus strobus region is a distinct ecological unit which is the climatic climax for the region where they occur. Most universally associated with these species are *Fagus grandifolia, Acer saccharum* and *A. nigrum,* and, in lesser proportions, a considerable number of additional species are often found.

While the distribution and commingling of these five species *(i. e., Tsuga canadensis, Pinus strobus, Fagus grandifolia, Acer saccharum* and *A. nigrum)* in the Appalachian, New England and northern Lakes regions is such as to appear to fully justify this treatment in these areas, the distribution in Indiana is such (4, 5) that it is less reasonable to consider them as members of the same ecological unit. Tsuga and Pinus not only have a very disjunct distribution in the state, but always occur under more xerophytic conditions than do Fagus and Acer. It would appear more reasonable under such conditions to think of them in Indiana as more xerophytic relict segregates of a former less differentiated climax. That is to say, former climatic conditions may have been such as to favor a less differentiated forest climax (Braun (1)) and, as climate has changed, this climatic aggregate has become segregated into component parts of which Fagus-Acer and Quercus-Carya are the only ones prominently represented in Indiana; the former on more mesophytic areas and the latter on more xerophytic areas, while Tsuga or Tsuga-Pinus associations occupy very few circumscribed areas intermediate in mesophytism between the other two segregates. None of the genera mentioned by Nichols as occurring with Tsuga and Pinus in the area under consideration in his paper is found with them in Indiana except Fagus, Acer and, less commonly, Quercus and Carya.

In Table I is given the average percentage of available soil moisture (total moisture minus wilting coefficient) for weekly periods from May to September in Tsuga, Tsuga-Pinus aud Fagus-Acer areas. It will be

TABLE I

AVERAGE AVAILABLE MOISTURE IN TSUGA OR TSUGA-PINUS AND FAGUS-ACER ASSOCIATIONS, MAY TO OCTOBER

	SOILS			
PINE HILLS, 1931	Surface	3-Inch	6-Inch	12-Inch
Mature Fagus-Acer	13.18		7.85	7.72
Mature Tsuga-Pinus on Slope	10.98		3.48	3.88
Mature Tsuga-Pinus on Terrace	10.68		6.64	4.56
TREVLAC, 1930 (4, 5)				
Mature Fagus-Acer	12.27	4.89	3.89	
Mature Tsuga	7.67	2.89	2.55	
Seedling Fagus-Acer	9.84	1.78	2.36	
Seedling Tsuga	7.26	1.78	2.67	
TURKEY RUN, 1929 (3)				
Mature Fagus-Acer	18.6	15.2	9.3	9.8
Mature Tsuga	7.7	—0.7	—1.3	—2.1

TABLE II

TIME IN WEEKS DURING WHICH SOIL MOISTURE IS BELOW WILTING COEFFICIENT IN FAGUS-ACER AND TSUGA OR TSUGA-PINUS ASSOCIATIONS

	SOILS			
PINE HILLS, 1931	Surface	3-Inch	6-Inch	12-Inch
Mature Fagus-Acer	6		6	0
Mature Tsuga-Pinus (Slope)	6		8	8
Mature Tsuga-Pinus (Terrace)	0		0	1
TREVLAC, 1930 (4, 5)				
Mature Fagus-Acer	5	7	9	
Mature Tsuga	9	9	12	
Seedling Fagus-Acer	5	10	9	
Seedling Tsuga	10	11	11	
TURKEY RUN, 1929 (3)				
Mature Fagus-Acer	0	0	0	0
Mature Tsuga	5	6	6	12

seen that in almost every case, whether it be in mature stands or in seedling stands, the average percentage of available moisture in Tsuga or Tsuga-Pinus areas is less than in Fagus-Acer areas, and in most cases the differences are considerable.

Not only is the average summer soil moisture less in Tsuga and Tsuga-Pinus areas than in Fagus-Acer areas, but in all cases except the

Tsuga-Pinus association occurring on a second terrace area in the Pine Hills district, the number of weeks during which the soil moisture content went below the wilting coefficient is greater in Tsuga and Tsuga-Pinus areas than in Fagus-Acer areas. Even in case of the Tsuga-Pinus second-terrace area, where the moisture content did not go below the wilting coefficient (Table II) so often as in the Fagus-Acer area, the content was near the wilting coefficient more often than in Fagus-Acer, so that the average available moisture is higher in the latter.

Clements (2) has shown that a relict association inhabiting a situation which is somewhat more xerophytic and located within what is generally a more mesophytic area should be considered a preclimax association, while one which occupies a somewhat more mesophytic situation located within what is generally a more xerophytic area should be considered a postclimax relict association. If these soil-moisture relations are definitive of the type of forest-climax relict, then Tsuga and Tsuga-Pinus associations in Indiana must be considered to be preclimax relicts, since they inhabit here more xerophytic situations as vegetative islands surrounded by more mesophytic Fagus-Acer areas.

LITERATURE CITED

1. Braun, E. Lucy. The undifferentiated forest climax and the associate-segregate. Ecology 16 (3):514-519. 1935.
2. Clements, F. C. The relict method in dynamic ecology. Jour. Ecol. 22 (1):39-68. 1934.
3. Daubenmire, Rexford F. The relation of certain ecological factors to the inhibition of forest floor herbs under hemlock. Butler Univ. Bot. Stud. 1:61-76. 1930.
4. Friesner, R. C., and J. E. Potzger. Studies in forest ecology. I. Some factors concerned in hemlock reproduction in Indiana. Butler Univ. Bot. Stud. 2:133-144. 1931.
5. —— *Ibid.* II. The ecological significance of hemlock in Indiana. *Ibid.* 2:145-149. 1931.
6. Nichols, G. E. Hemlock-white pine-northern hardwood region of northeastern North America. Ecology 16 (3):403-422. 1935.